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DESIGN AND DEVELOPMENT IMPACT ANALYSIS OF NUCLEAR POWER PLANT (NPP) IN WEST KALIMANTAN WITH GEOGRAPHIC INFORMATION SYSTEM BASED

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Abstract

West Kalimantan can be considered to be the location of the construction of Nuclear Power Plant (NPP) because it has advantages in efficiency of nuclear power plants that generate electricity are stable. This study is intended to create a model of the nuclear power plant in West Kalimantan with purpose: Factor analysis of the condition of the strategic location of physics, chemistry soil, water and air, socioeconomic factors, durability and environmental safety of nuclear power plants planned location of West Kalimantan.

The method used to achieve the objectives of research at an early stage is to analyze factors of strategic conditions asfek physics, soil chemistry, water and air spacial analysis by mapping using GIS software (Geografic Information System) and the analysis and identification of physical and chemical characteristics of the soil region study and analysis to the socio-economic data, robustness and security community supported Kalimantan Survey methods and verification of real conditions.

Analysis of the data obtained in the study area of West Kalimantan in achieving the first goal in this study was obtained from the data results that are most likely locations for the study area considered to be the next study in the design of a nuclear power plant, the locations between others come in Sambas, Singkawang, Ketapang and Kayong north. Of matrix analysts and various considerations for all districts, has found that the most probable district is Ketapang district although it has its disadvantages include a relatively high wind speeds, but of all the consideration of all the districts of the city, the Ketapang district can be considered for the study Further in determining the location of nuclear power plant construction, which in turn can be focused to the area districts with a more comprehensive study.

Key words: nuclear power plant (NPP), uranium, spatial, GIS (Geografic Information System)

INTRODUCTION

Electricity supply in West Kalimantan is an important part of energy resources due to electricity is the main basic needs as an engine of development. Electricity generated from the power plant will be instrumental in promoting various aspects of development and in general have an important contribution in promoting economic growth and progress in all areas of life of the Indonesian nation.

An important reason for the West Kalimantan to be able to build a nuclear power plant can be seen from the point of view of the geographical location influence the structure of the earth's crust causes a large earthquake with a relatively small risk of accidents. Likewise, it can be seen from the low number of population with an area of two and a half times larger than the

island of Java, therefore West Kalimantan radiation impact population per area is relatively small, so it has a fairly small nuclear impact. Another important potential of West Kalimantan has reserves of uranium fuel (fuel NPP) with the greatest number in Indonesia, which can be used as collateral NPP operational sustainability. Uranium fuel reserves in West Kalimantan, which are located in Bukit Ekoremaja Elailir Melawi with uranium minerals ((uraninite, Branerit. Davindit and Gummit) with a reserve of about 12 409 tonnes of U3O8 over (Affandi, 2000).

Electricity crisis that has hit areas including West Kalimantan which requires anticipation supply electrical energy supply can be continued with high stability with abundant fuel supply. This issue can be addressed by one of the alternative development is through the construction of a nuclear power plant in West Kalimantan. Electricity crisis continues to increase with an increase in the number of people who pose a high Indonesia's large population can not enjoy electricity, if it can not be anticipated, the coming years lead to the increase of poverty and reduction of public education that impede the progress of the development of Indonesia.

The island of Borneo and other islands besides Java requires about 300 PJ (Petajoules - 1015 Joules). PLN in 2006-2015 RUPTL planning does not reach the target in accordance with the original plan. On the islands of the Outer conditions experienced by the current crisis continues which has a target of electrification ratio of approximately 70% and the ratio of the area of electrified around 90% with 44 million customers are not achieved, due to a number of constraints, especially fuel constraints. Management of the availability of electricity from start to generation, transmission and distribution PLN grew only 1.43% per year have not been able to meet the needs of all the people of Indonesia, so that only 13.6% of Indonesia's population that served the needs of electricity (IAEA 2002).

In many countries there are currently nine hundred (900) has all operating nuclear reactors, which includes about 280 small reactors used for research into the production of isotopes for medicine and industry in 56 countries. More than 200 small reactors patient care around the 150 ships and on the statistical data of nuclear power plants in the world in 2002 and 2009 were 439 nuclear power reactors operating in 31 countries around the world with a total capacity of about 360064 GWe, 35 nuclear power reactors with a capacity of 28087 MWe are under construction as well as 25 nuclear power reactors with a capacity of 29385 MWe, and four new nuclear power reactors will be built in several countries in Asia and Eastern Europe. Of the 439 nuclear power reactors that operate in the world, has met 17% of the world's electricity. Industrialized countries in the world, 25% of its electricity comes from nuclear reactors, for example in the United States there are 104 nuclear power reactors that already meets 20% of the country's electricity needs. Japan and France continue to build nuclear power plants every few years to meet its electricity needs.

Asian countries that have met the needs of the NPP is the Japanese linstriknya although recorded as the most earthquake-prone countries, as well as the Chinese state has the largest population in the world was not an obstacle in building nuclear power plants in order to meet the energy needs of its population. Therefore, Indonesia by looking at the success of other countries need to consider the option of nuclear power plants to overcome power crisis by preparing all the resources and mastery of technology as quickly as possible.

Indonesia has the sources of uranium as nuclear fuel, one of which is located in West Kalimantan Kalan which has reserves of about 12 409 tonnes of U3O8 over, with the largest reserves are in EkoRemaja sector. Kalan Ekoremaja uranium ore containing minerals other than uranium (uraninite, branerit. Davindit and gummit) still contains minerals such as pyrite association, pyrrhotite, kalkoporit, cobaltite, lollingit, pentlandite, gerdorsfit, saflorit, sphalerite, molybdenite, ilmenite, magnetite and chlorite (Andayani 1986).

In planning the construction of a nuclear power plant, should be preceded by doing research on the identification of the role of geological data to take into account the opportunities and maintain the possibility of earthquakes in the locations of nuclear power plants. It takes

several stages of the process of selecting the location of the site selection stage, the stage of determining the location and stage of evaluation. To arrive at the nuclear power plant construction process takes a long time which include siting, construction planning, and operational oversight and ongoing monitoring. Natural phenomena other than earthquake also need to be taken into account other conditions such as the influence of topography, morphology, erosion, flooding and rock mass movement that could threaten nuclear power plants. Surface water conditions in the form of rivers that form a pattern with a fine up to coarse density is also necessary to study. Free ground water at a certain depth and a unit of feet of volcanic plateau of rocky bumpy be a material consideration in determining the location of the nuclear power plant.

The main issues for the purpose of construction of nuclear power plants is how the feasibility of building a nuclear power plant in West Kalimantan from factor analysis of the condition of physics, chemistry soil, water and air location, socio-economic factors, durability and environmental safety of nuclear power plants Location Plan? And the long-term goal of this research is to analyze the factors shape the strategic location of aspects of physics, chemistry soil, water and air, socioeconomic factors, durability and environmental safety at nuclear power plants in West Kalimantan Area Plan. Selin, the specific objectives of this research is to (a) analyze the RBI map / aerial photographs of West Kalimantan for the construction of nuclear power plants; (b) Analyzing Chemistry-Physics Soil, water and air Kalimantan-based geographic information system (GIS); (c) To analyze the socio-economic factors resilience and security of the community-based geographic information system (GIS). Expected research has benefits include: (a) to provide an alternative solution to the energy crisis of national electricity; (b) In the direction of decision-making for many stakeholders and the wider community.

RESEARCH METHODS

Location of the study is that the province of West Kalimantan with an area 146 807 km2 (7.53% of Indonesia). West Kalimantan geographic conditions have hundreds of large and small rivers. Several large rivers is still a pulse and the main line to transport the hinterland. West Kalimantan land borders with the state of Sarawak, Malaysia.

Materials and research tools such as search source material: Map of the earth in such a West Kalimantan, ArcGIS Software, SPSS, MS-Excel, and Laboratory Equipment for environmental analysis as well as data BMG, CBS, BATAN and other sources.

Data collected by literature study and observation both primary data and secondary data. Types of data collected in the form of quantitative and qualitative data and research materials from a variety of data support previous studies related to West Kalimantan which includes data analysis of soil, water from the study area to determine the content of the main elements as well as other geographical observation data relating to real current conditions in area of research. In addition, the data needed rainfall, wind, land use obtained from reliable institutions such as BMG, BATAN and BPS are processed and reprocessed in accordance with the purpose of research.

DISCUSSION

Urgency nuclear power plant in West Kalimantan Nuclear Power Plant (NPP) for West Kalimantan in particular is a provider of alternative power supply. NPP is part of a strategy of long-term national electric power which is intended for the benefit of the people of the energy contained in Law No. 10 of 1997 on nuclear energy. Electricity supply in West Kalimantan is crucial to the understanding that electricity is the main basic needs as an engine of development that will play a role in promoting various aspects of development, both education and welfare aspects that contribute to improving the economic growth and progress in all areas of national life.

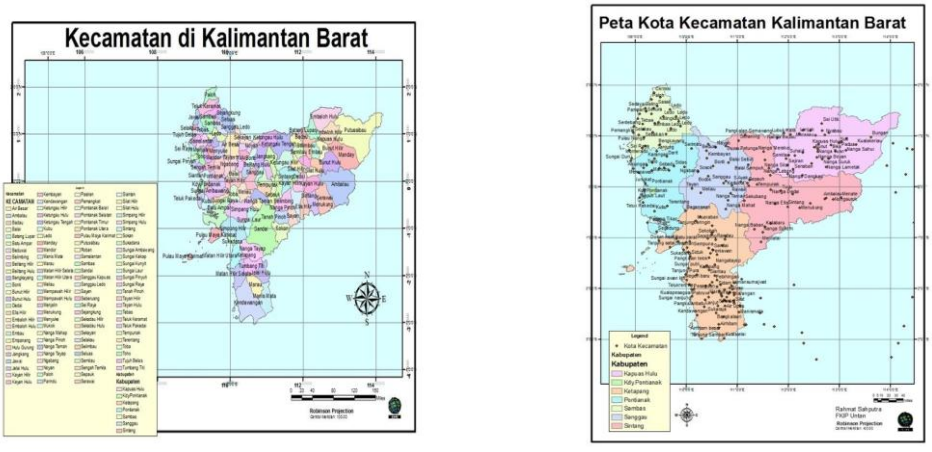
Urgency for West Kalimantan in building nuclear power plants, can be seen from the point of view of the geographical location influence the structure of the earth's crust causes a large earthquake with a relatively small risk of accidents. Likewise, it can be seen from the low number of population with a large area, therefore the West Kalimantan has the impact of radiation on population per area is relatively small. Another important potential of West Kalimantan has reserves of uranium fuel (fuel NPP) with the greatest number in Indonesia, which can be used as collateral NPP operational sustainability.

Environmental Conditions western Borneo West Kalimantan region has been the focus of environmental studies covering 14 districts / cities located in West Kalimantan. The name of the city district is shown in Table 1.

Table 1: Number of districts in the regency / city in the study area

No.	Regency / City	Government Center	District
1.	Kab. Bengkayang	Bengkayang	17
2.	Kab. Kapuashulu	Putussibau	23
3.	Kab. Kayong Utara	Sukadana	5
4.	Kab. Ketapang	Ketapang	21
5.	Kab. Kubu Raya	Sungai Raya	9
6.	Kab. Landak	Ngabang	10
7.	Kab. Melawi	Nanga Pinoh	11
8.	Kab. Pontianak	Mempawah	9
9.	Kab. Sambas	Sambas	19
10.	Kab. Sanggau	Sanggau	15
11.	Kab. Sekadau	Sekadau	7
12.	Kab. Sintang	Sintang	14
13.	Kota Pontianak	Pontianak	6
14.	Kota Singkawang	Singkawang	5
		Total	171

Digitization map to obtain the Kalimantan region as an area of study, with the collection of road maps, maps of the districts, district maps, road maps and maps of the river flow and the map of the districts. There is an area adjacent to the sea water sources include Sambas, Singkawang, Pontianak and Ketapang. Other regions bordering other provinces and no district directly adjacent to other countries. District located in the district in the study area covers 108 sub-districts (Figure 1a). Data from 108 sub-districts in the map are analyzed further to the discovery of the region will be the subject of attention and will be the focus of further with some criteria to be used as a nuclear power plant design area.



(a) (b)

Figure 1. (a) Map of districts which are in the study area; (b) urban centers in each district

Figure 1 (b) shall be considered as the access of the population and further consideration in the design of the study area for the construction of nuclear power plants. Another thing to consider to facilitate access to the construction of nuclear power plants, among others, the need for roads and analysis of the existence of the existing road, to the needs of the next stage which can facilitate access to activities and development. Therefore, access roads, including parts that are the focus of attention for the feasibility and ease of development of nuclear power plants.

Other criteria of concern is the existence of streams in consideration of nuclear power plant, given in the design and construction of nuclear power plants need to pay attention to waste components that are related to the flow of river water. Required considerations relating to the territories and districts that have access to the adjacent sea areas. Therefore, the necessary buffering area that will be the study of the nuclear power plant design, which is a map of the study with buffering 10 miles of coastline as in Figure 2 as follows.

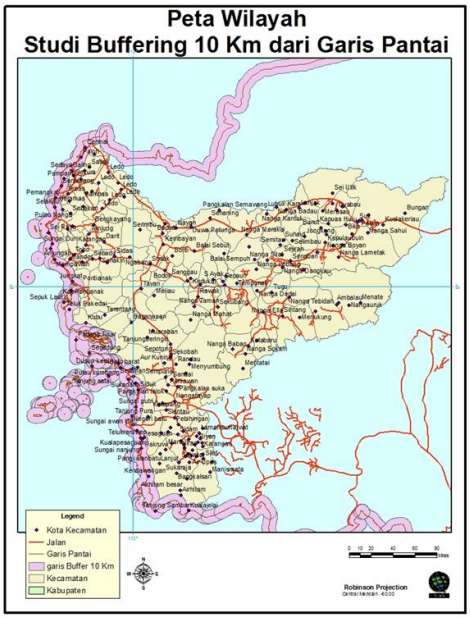


Figure 2. Map of the area buffering 10 miles of shoreline.

Analysis of Physical Chemistry west Kalimantan area

The type of soil that is generally found in the study area consists of volcanic soils consist of: (a) Land Andosol which generally has a gray color to yellow, sensitive to erosion, and very fertile used as agricultural land, plantation, forest pine or fir (b) Regosol, generally have characteristics of coarse grained, gray to yellow and low organic matter content used for farming rice, sugarcane and coconut and others; (C) Alluvial Soil (Soil Deposition), generally have the characteristics of gray and sensitive to erosion which is used as agricultural land paddy and pulses. Another ne type Organosol Land consisting of Soil Humus with features including a blackish color, easy to wet, organic matter, very fertile agricultural land; Peat soil with traits are highly acidic, low nutrient that is not fertile for farming purposes tidal

There are also types of soil Soil Latosol (rocky soil) generally have characteristics with diverse soil texture and is generally sandy, not textured, color content of rock, gravel and fertility varied utilization used for reeds and woods. The other type is the Land Podzol generally have characteristics with pale color, high content of quartz sand, very sour, sensitive to erosion, less fertile. Data acquisition rainfall in the study area are presented as Table 2 below.

Table 2. Data of rainfall in the study area

District	Rainfall (mm)	Average monthly amount of rainfall (mm)	Wind speed / knot
Sintang	249,42	23	
Kubu Raya	260,8	18	2
Kab. Pontianak	173,7	17	4,1
Kapuashulu	374,6	22	
Kayong utara	223,17	11,92	
Kota Pontianak	289,66	18,25	2,8
Singkawang			
Landak	174	17	4,1
Melawi	331,25	18,58	1,92
Sanggau			
Sekadau			
Sambas	284,08	20	
Ketapang	220,4	14,8	5

Table 2 shows that the province has an average rainfall is quite high and evenly for each region, but has a different wind speeds in each area.

Population density (density) study area of 14 districts in the city of West Kalimantan are presented in Figure 3 which shows that in urban areas such as the city of Pontianak, Singkawang has a relatively high population density with a value of 5156.243 Soul / km2 and 386.7103 Soul / km2, while other districts are still relatively low. The graph shows that there is a low density for several districts, among others Sintang district, Kapuashulu, Melawi and Ketapang.

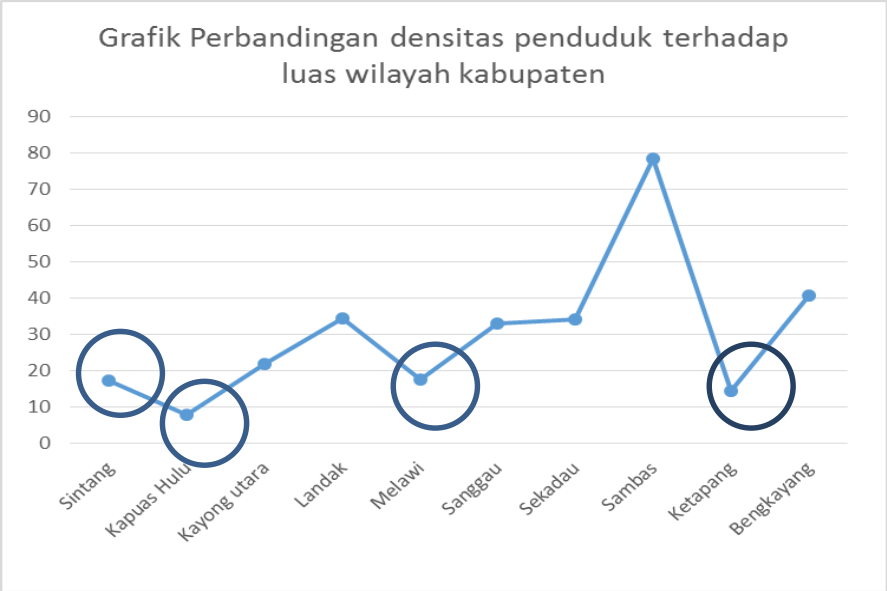


Figure 3. The density of the population of the area of study.

Preliminary recommendations

The results of the data obtained and analyzed obtained after several recommendations that can be taken into consideration. This consideration is obtained from the analysis of physical

chemistry as well as regions and demographic factors, which are obtained from the data type of soil, rainfall, wind speed, access roads, watersheds, and taking into account the characteristics of each spatial region by overlaying with ArcGIS that generates the data map spatial location in West Kalimantan for the construction of nuclear power plants. The results of the above analysis can be seen in the matrix in Table 3 below.

Table 3. Matrix Analysis for consideration zoning decision be continued focus on the construction of nuclear power plants.

City / County	GIS Analysis	The proximity of Water Resources and the Sea	Analysis of physical chemical properties of the soil	Analysis of Rainfall	Wind Velocity	Analysis of Population Density	Proximity Raw Uranium
Sintang	×	×	√	√	√	√	√
Kubu Raya	×	×	√	√	√	×	×
Kab. Pontianak	√	√	√	√	×	×	×
Kapuashulu	×	×	√	√	√	√	×
Kayong utara	√	√	√	√	√	×	×
Kota Pontianak	×	×	√	√	√	×	×
Singkawang	√	√	√	√	√	×	×
Landak	×	×	√	√	√	×	×
Melawi	×	×	√	√	√	√	√
Sanggau	×	×	√	√	√	×	×
Sekadau	×	×	√	√	√	×	×
Sambas	√	√	√	√	√	×	×
Ketapang	√	√	√	√	×	√	√
Bengkayang	√	×	√	√	√	×	×

CONCLUSION AND SUGGESTION

The study of 108 districts in West Kalimantan on the data type of soil, rainfall, wind speed, access roads, watersheds used sources of spatial map data by considering the characteristics of the environmental data of land, water and air each region to perform overlay using ArcGIS for nuclear power development plan, has produced a spatial map data location in West Kalimantan for consideration and decision of the nuclear power plant has been acquired environmental data as a recommendation in the design of nuclear power plant in West Kalimantan.

Further research is needed with regard to in-depth study of all aspects of the environment in the entire region of West Kalimantan, and carried out further refinement of the method is done.

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